GEMaC
Groupe d'Étude
de la Matière Condensée

A NEW CRYSTAL PHASE IN SEMICONDUCTOR NANOWIRES

GEMaC researchers, in partnership with the LEM (CNRS-Onera), have produced and characterised an original and unexpected crystal structure in nanoscale zinc sulphide (ZnS) wires.

The crystal structure of a material describes the way in which the atoms of the solid arrange themselves in space. This arrangement determines the properties of the material. For example, diamond and graphite are both composed of only carbon atoms, but their different crystal structures give them opposite properties: diamond is transparent and insulating, while graphite is opaque and conductive.

Zinc sulphide (ZnS) is a compound well known to physicists, particularly for its phosphorescent properties. This material can exist in principle in many crystalline phases, but some of these are not stable and have therefore never been observed in bulk material. On the other hand, on the scale of nanostructures such as nanowires, they can be made using the means and techniques of crystal growth from semiconductor science.

The specific conditions for the growth of zinc sulphide nanowires have been developed at GEMaC. The method consists of first obtaining nanometric droplets of gold-gallium alloy on a substrate, then introducing sulphur and zinc precursors, which will constitute the nanowire, into a deposition reactor (in the vapour phase). The gold-gallium catalyst thus induces the vertical growth of a wire under the droplet (see figure). This technique has made it possible to produce a new crystalline phase of ZnS, called 15R. This phase could open the way to the study of new properties of this semiconductor, for original applications in optics and nanotechnologies.

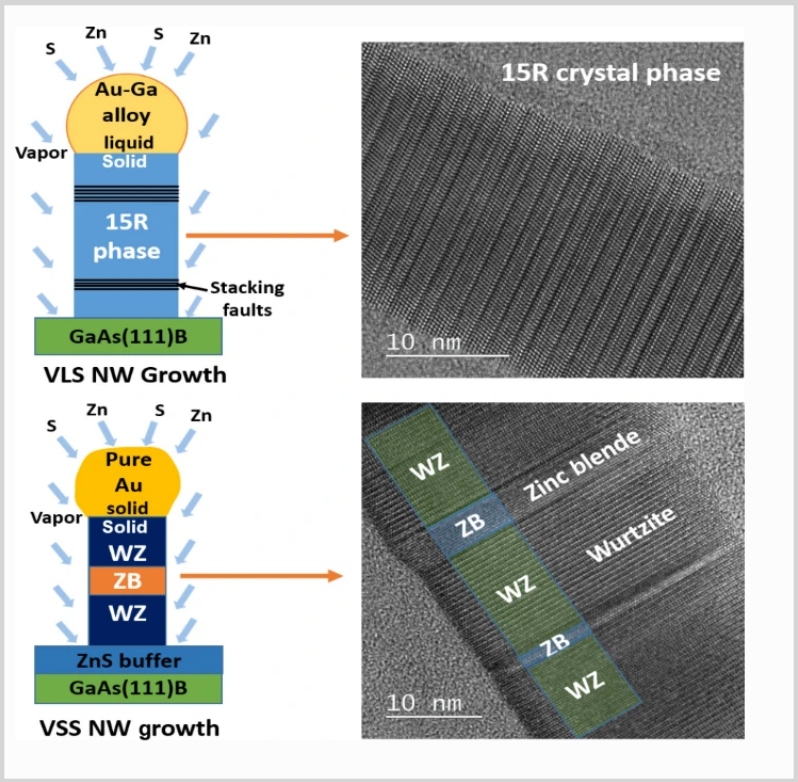

Figure : Top: Growth of a nanowire using a drop of liquid gold-gallium, giving rise to the new 15R phase. Bottom: growth using a solid gold particle gives rise to a known phase alternation, cubic or hexagonal. The images on the right are taken with a transmission electron microscope.

S. Kumar, F. Fossard, G. Amiri, J.-M. Chauveau, V. Sallet,
"Induced structural modifications in ZnS nanowires via physical state of catalyst: Highlights of 15R crystal phase",
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Contact : vincent.sallet@uvsq.fr